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# China: The Steel Industry In the 1970s and 1980s

A Research Paper

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# China: The Steel Industry In the 1970s and 1980s

## Key Judgments

The People's Republic of China has launched a massive effort to boost steel production rapidly to help raise the country to a first-rate industrial power by the end of the century. Last year the Chinese leadership called for a doubling of steel output to 60 million metric tons by 1985 and started a major construction program to provide the needed capacity at all stages of production. Recently, however, the PRC has begun to doubt the feasibility of the program and has begun to cut back its original goals.

### *Broad Scope of the Program*

In February 1978 Premier Hua Guofeng announced that China planned to build or expand 10 major steel centers under the current 10-year economic plan (1976-85). The program called for constructing two or three new complexes and upgrading seven existing steel centers. The Chinese have already started work on a new 6-million-ton plant at Baoshan (Pao-shan) near Shanghai and are negotiating with West Germany and Japan for a proposed 10-million-ton plant to be located east of Beijing in Hebei (Hopeh) Province. In addition, the Chinese have entered into preliminary discussions with a number of Western firms for help to modernize several existing steel mills. Most of the new plant and technology must come from the West because the Chinese lack the know-how to build large-scale, integrated plants.

Chinese plans also call for simultaneous improvements in the long-neglected iron ore sector. Although iron ore reserves are huge, most deposits are of low quality and require extensive upgrading before they are suitable for ironmaking. China has reached preliminary agreements with three US firms for development of four iron mines and pelletizing facilities. As many as 14 mines could ultimately be developed under the current plan. Some of the mines could eventually rank among the largest in the world.

### *High Cost*

Modernization of the steel industry will be expensive. The Baoshan complex will probably cost $3-4 billion, and the plant proposed for Hebei Province could run as high as $14 billion. Upgrading existing plants could cost more than $10 billion in hard currency, depending on how much of the work is done by the Chinese themselves. In addition, iron ore mines and beneficiation facilities could add another $5-10 billion to the total. Hard currency spending could thus reach $40 billion by the time the current plans are finally achieved.

*Overambitious Goals*

The Chinese are beginning to realize that China lacks the human and material resources and the infrastructure to carry out the program by 1985. Construction personnel and the material inputs needed to erect imported facilities are in short supply, as are skilled managers and technicians with the know-how to operate modern iron and steel plants. Moreover, the enormous scope of the plan would require huge investment resources badly needed in light industry and agriculture. In the longer run, all of these problems may be overcome, but meanwhile the Chinese leaders have been cutting back the 1985 steel target, perhaps settling on a more feasible 45 million tons. Achievement of this target would still ensure that the PRC retained its position as the world's fifth largest steel producer—behind the USSR, the United States, Japan, and West Germany.

*Sizable Imports*

The poor production record of the 1970s—largely attributable to the political turmoil centering around the succession struggle of 1974-76—forced Beijing to expand iron and steel imports sharply in recent years; steel is now the largest single category in China's import bill. Steel imports reached almost $1.5 billion in 1977, nearly four times the figure for 1970. Finished steel items—primarily plate, sheet, tube, and pipe—account for about 90 percent of Chinese purchases and probably reached 7 million tons last year. Japan is the largest supplier, accounting for more than 70 percent of China's imports.

China will need to import steel products well into the 1980s. Although domestic output of crude and finished steel no doubt will rise substantially above the 32 million tons produced last year, output will be insufficient to supply the quantity, quality, or variety of products required for the stepped-up modernization program. Purchases abroad will continue to be dominated by finished steel products; at the same time, growing amounts of iron ore will be bought until domestic ore mining and ore-preparation facilities are greatly expanded.

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# China: The Steel Industry In the 1970s and 1980s

## Historical Development

### *Soviet Influence*

Since it came to power in 1949 the leadership of the People's Republic of China has viewed the development of a strong steel industry as a high national priority. With extensive Soviet aid, the Chinese began to rebuild war-ravaged steel plants immediately after the Communist takeover. The Soviet Union provided advisers, technology, and equipment for this task. Initial projects included reconstruction of the steel mills at Anshan (An-shan), Benxi (Pen-chi), Taiyuan (T'ai-yuan), and Maanshan (Ma-an-shan). In addition, new plants were started at Wuhan and Baotou (Pao-t'ou) (see map, figure 1).

Steel output expanded smoothly during the early 1950s. Production surpassed the pre-Communist high of 900,000 tons by 1952 and reached 5.35 million tons in 1957, the final year of the Soviet-style First Five-Year Plan. In addition to the large increases in production, Chinese mills turned out a growing variety of products and raised productivity as more efficient equipment was installed. Under Soviet tutelage, more and more Chinese became experienced in operating and managing steel facilities.

### *The Great Leap Forward*

Despite steady progress in steel and other branches of industry, Chairman Mao felt that growth could be even more rapid, and in 1958 he launched the Great Leap Forward, an ill-advised attempt at instant industrialization. Small iron and steel plants sprang up all over the country. These plants featured the notorious backyard furnaces and small, obsolete side-blown converters for making steel. Output from these primitive facilities gave rise to exaggerated claims of huge increases in steel production. The Chinese claimed, for example, that steel production more than doubled in 1958 and jumped another 70 percent by 1960.

Simultaneously, the Chinese proceeded with the construction of modern plants. Installation of equipment was speeded up, and capacity at the large plants reached about 12 million tons by the end of 1960. The Chinese reported that output from the large plants exceeded their rated capacity, reaching almost 13 million tons in 1960. These plants were operated around the clock with little attention to maintenance or repair. The new small-scale plants added another 6 million tons of steel production. The steel from small plants was nearly useless, however, and the low quality of ores and pig iron used at the modern plants reduced the quality of their output as well.

### *Retrenchment*

Following the Great Leap Forward, China closed almost all of the small facilities and began to repair the damage done to the large steel mills. Production fell from a claimed 19 million tons in 1960 to an estimated 8 million tons in 1961 and stayed at that level through 1963.

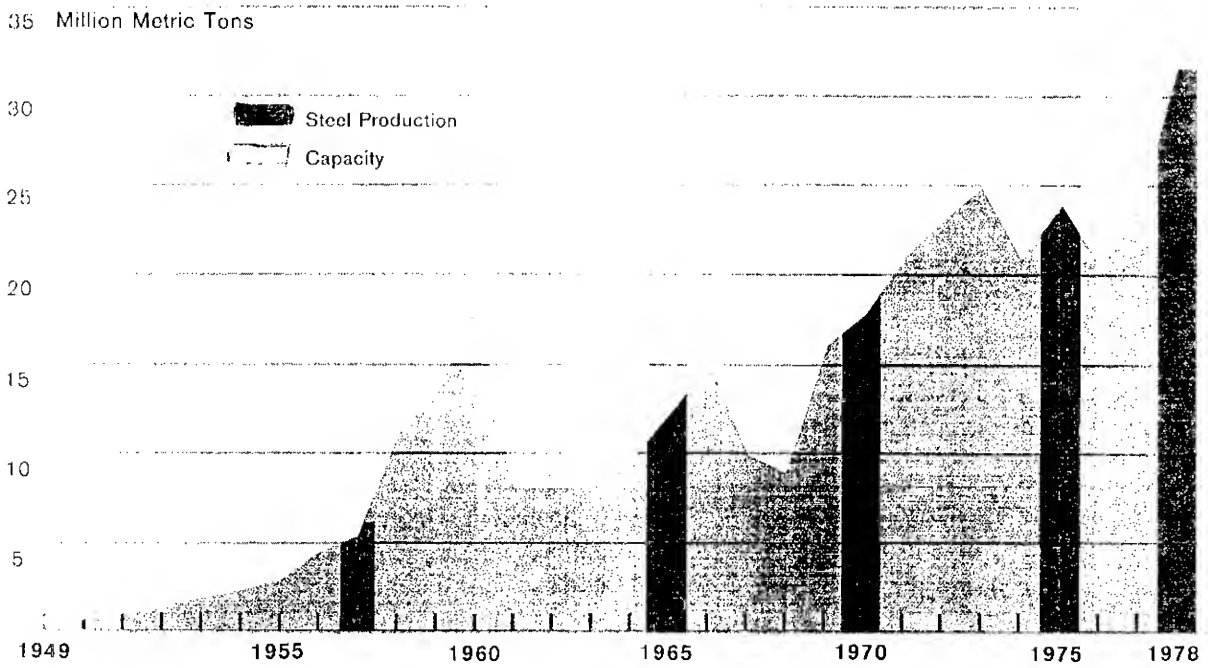
During the period of comparatively moderate policy (1961-65), China began to look to the West for modern steelmaking technology. After Krushchev pulled out the Soviet advisers and their blueprints in mid-1960, China was unable to push forward its steelmaking technology on its own. Accordingly, it bought basic oxygen furnaces from Austria and electric furnaces and air separation plants from Japan. Steelmaking capacity reached almost 18 million tons by yearend 1965 and production advanced to 15 million tons in 1966 (see figure 2). The new plants at Wuhan and Baotou contributed growing amounts of steel and steel products, and selective improvements boosted production at existing plants. Although production still lagged behind the spurious claim of 1960, quality was vastly improved and a wider variety of finished products was produced.

### *The Cultural Revolution*

The Cultural Revolution (1966-69) caused another downturn in the steel industry. In 1966, when the Red Guards were being mobilized, production climbed to 15 million tons, then plummeted to 10 million tons in 1967 and dropped further to only 9 million tons in

China: Steel Production and Capacity

Figure 2

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1968. Factional fighting and political demonstrations disrupted many steel plants, and the vast numbers of Red Guards traveling around the country overwhelmed the transportation system. Political disturbances also hurt the coal industry, and shortages of coking coal further impeded steel production. Compared with the Great Leap Forward, however, these problems were minor and temporary. Despite sporadic interruptions in supplies of construction materials, the Chinese maintained a vigorous investment program in steel and other industrial branches during the Cultural Revolution; steel capacity stood at about 24 million tons in 1970.[1]

## Production in the 1970s

After the interruptions of the Cultural Revolution, steel production advanced rapidly, doubling between 1968 and 1970 (see table 1). The PRC had utilized only about 40 percent of its steelmaking capacity in 1968; almost 13 million tons of operable capacity was standing idle. The return of political stability enabled managers to quickly activate a large part of these facilities. In 1973, steel production reached a record 25 million tons. In addition, China reintroduced small steel plants during this period. These plants, which were much improved over the earlier facilities, used nearby materials and labor to produce iron and steel for local consumption. Construction of small plants helped boost the 1975 capacity level to about 30 million tons.

### *Gang of Four Disruptions*

In 1974-76, political disturbances associated with the Gang of Four faction and the struggle over the succession to Chairman Mao sharply depressed steel output. Production in both 1974 and 1976 amounted to only 21 million tons, whereas in 1975, a comparatively orderly year, production was at 24 million tons. Massive in-plant disruptions, factional fighting, and political rallies were common, particularly at the large

[1] For a more detailed discussion of the steel industry in the 1950s and 1960s see "China's Iron and Steel Industry," *China: A Reassessment of the Economy*, Joint Economic Committee, 94th Congress, 1st Session, 10 July, 1975, pp. 264-288.

**Table 1**

**China: Steel Production**

| Year | Million Metric Tons | Year | Million Metric Tons | Year | Million Metric Tons |
|---|---|---|---|---|---|
| 1949 | 0.158 | 1959 | 13.35 | 1969 | 16 |
| 1950 | 0.606 | 1960 | 18.67 | 1970 | 17.8 |
| 1951 | 0.896 | 1961 | 8 | 1971 | 21 |
| 1952 | 1.349 | 1962 | 8 | 1972 | 23 |
| 1953 | 1.774 | 1963 | 8 | 1973 | 25 |
| 1954 | 2.225 | 1964 | 9.6 | 1974 | 21 |
| 1955 | 2.853 | 1965 | 12.2 | 1975 | 24 |
| 1956 | 4.465 | 1966 | 15 | 1976 | 20.5 |
| 1957 | 5.35 | 1967 | 10 | 1977 | 23.7 |
| 1958 | 11.08 | 1968 | 9 | 1978 | 31.7 |

plants at Wuhan and Anshan. The Chinese reported, for example, "In the three years of 1974-76 the Gang of Four faction caused the Wuhan Iron and Steel Company to lose one and one-half years' output." The steel industry was further affected in July 1976 by the major earthquake that hit Tangshan. The Tangshan steel plant—a 1-million-ton producer—was heavily damaged, with the Kailuan (K'ailuan) coal mine at Tangshan also hard hit. Loss of output from the Kailuan mine, a leading producer of high quality coking coal, forced sharp cutbacks in operations at Anshan and mills in the Beijing area.

***Return of Stability***

The recovery after the downfall of the Gang of Four (October 1976) has been swift. China's new leadership has strongly emphasized the need to increase production, and, with the return of political stability, the steel industry has rebounded. In 1978, steel output reached almost 32 million tons, finally surpassing the 1973 peak.

The situation confronting the Chinese steel industry after the fall of the Gang of Four was similar to the situation in the aftermath of the Cultural Revolution—China's ability to increase steel production by more than 11 million tons between 1976 and 1978 again rested on the existence of large amounts of underutilized capacity. Capacity utilization in 1976 was under 70 percent, with almost 10 million tons of operable steelmaking capacity lying idle. In late 1977,

**Table 2**

**Selected Countries: Steel Production, 1978**

| | Steel Production (Million Metric Tons) | Per Capita Production (Kilograms) |
|---|---|---|
| USSR | 151.0 | 577.7 |
| United States | 124.0 | 567.8 |
| Japan | 102.1 | 887.8 |
| West Germany | 41.2 | 670.0 |
| China | 31.7 | 31.6 |
| Italy | 24.3 | 428.6 |
| France | 22.8 | 427.0 |
| United Kingdom | 20.3 | 363.1 |
| Poland | 19.3 | 551.4 |
| Czechoslovakia | 15.3 | 1,013.2 |
| Brazil | 12.1 | 104.9 |
| India | 9.5 | 14.4 |
| Mexico | 6.4 | 97.3 |

moreover, 3-4 million tons of new capacity came on line with the completion of a 1.5-million-ton blast furnace at Anshan and the activation of new steelmaking facilities at Wuhan and Benxi. These additions boosted total capacity to about 34 million tons in 1978.

The spurt in production in 1978 lifted China to fifth in world output—behind the Soviet Union, the United States, Japan, and West Germany. China's high standing in aggregate steel production contrasts with its low ranking in per capita production—31.6 kilograms per capita in 1978. Brazil, for example, has a per capita output over three times that of China. Compared with developed countries, China's per capita output is only about 5 percent of US per capita output and 4 percent of Japan's (see table 2). On the other hand, China produces more than twice as much steel per head as India.

***Iron and Steel Plants***

China's 34 million tons of capacity is divided among approximately 300 plants that produce iron, steel, or iron and steel. The most famous is the integrated facility at Anshan, which produced more than half of China's steel in 1957 and still produces more than one-

fifth. This plant, together with the other eight or nine facilities capable of producing 1 million tons or more per year, account for 80 to 90 percent of total production. Other large plants are located at Shanghai, Wuhan, Baotou, Beijing, Chongqing (Chungking), Maanshan, Taiyuan and Benxi. In addition the Chinese recently announced the existence of a new facility Banzhihua (Panchihhua) in southern Sichuan (Szechwan) Province—that qualifies as a large plant. (U)

With the exception of the Shanghai plant, all of China's major steel mills are located near domestic supplies of coal and iron ore. The Shanghai mill, the only plant with a coastal location, produces small amounts of pig iron. It is primarily designed to make and finish steel from pig iron produced at other locations. Consequently, ready access to iron ore is unnecessary. The Banzhihua plant's remote location was chosen as part of China's policy of dispersing industry for defensive purposes.

The vast majority of the medium and small plants operate near the bottom of the technological scale and in the main provide low-quality iron for local consumption. The typical small plant probably produces less than 5,000 tons of steel yearly. Some of the medium-sized plants, however, make an important contribution to the industry's output. The Fulaerji (Fu-la-erh-chi) plant is a leading producer of high-quality alloy steel, and the plant at Tangshan, reconstructed after the 1976 earthquake, produces almost 1 million tons of steel annually. Other important medium-sized facilities are found at Daye (Ta-ye), Guangzhou (Canton), Jiangyou (Chiang-yu), Luda (Dairen), Xiangtan (Hsiang-tan), Xuanhua (Hsuan-hua), Kunming (K'un-ming), Shenyang (Shen-yang), and Tianjin (Tientsin).

## Structural Imbalance

The erratic growth of China's steel industry has made the task of carrying out a coherent development strategy extremely difficult. Planners have had to contend with recurrent political upheavals, changing economic priorities, and interruptions to the inflow of foreign technology. Consequently, the industry has been characterized by pronounced imbalances—many of which persist to this day. Output of pig iron lags behind the needs of the steel furnaces, and blast furnace requirements for iron ore are not being met. Similarly, China's steelfinishing sector is unable to process the outflow of crude steel.

### *Steelmaking*

The production of crude steel is the strongest stage of China's steel industry. In the 1950s the USSR provided the equipment and technical support to construct numerous large, modern open-hearth furnaces (OHFs). Productivity at these furnaces has been improved through the use of oxygen injection, and today the open hearths account for 60 to 70 percent of capacity. Basic oxygen furnaces (BOFs), which dominate steelmaking in most advanced countries, account for only 15 to 25 percent of Chinese capacity. The USSR had only begun to provide basic oxygen technology when it withdrew its technicians in 1960, and China has been slow to introduce this technology on its own. Today, most new Chinese steel furnaces are BOFs. Electric furnaces represent 5 to 10 percent of capacity and produce high-quality and specialty steels, while the outmoded side-blown converter is the standard furnace at local steel mills.

### *Ironmaking*

China, a net exporter of pig iron in the 1950s and 1960s, has had to import growing quantities in recent years. Growth of pig iron production in the 1970s has not matched China's capacity to make steel and cast iron products. The Chinese have recognized this deficiency; a new 1.5-million-ton blast furnace was completed at Anshan in 1977, and a new 800,000-ton furnace was recently completed at Maanshan. Other new blast furnaces are reportedly under construction.

The Soviet Union provided China with a large number of blast furnaces in the 1950s. After the Soviet withdrawal the PRC continued to construct its blast furnaces according to Soviet designs. These furnaces are generally well constructed, and the addition of modern instrumentation has improved operating efficiencies.

The greatest problem confronting China's blast furnace operators is the poor quality of the metallic blast furnace burden. China is almost completely dependent on sintering of low-quality ore for blast furnace feed. Most Chinese ores, however, are poorly suited to this type of beneficiation. Foreign technicians who have visited Chinese steel plants have estimated that the PRC could increase its pig iron output 20 to 30 percent by adopting more appropriate beneficiation and agglomeration practices.

Strains on iron supplies also are increased by limitations on the supply of scrap in China. The PRC, with its short history of industrialization, has not had much time to build up backlogs of aged and discarded metal goods. In addition, shortages of both consumer and capital equipment leads to long extensions of service life. This general scrap shortage forces the Chinese to use a high proportion of hot metal in the steel furnace charge.

*Steelfinishing*

Steelfinishing has been the weakest sector of the industry since the 1950s. Although the Soviets provided some finishing mills under their aid program, finishing capacity failed to grow as rapidly as iron or steelmaking capacity. At the Wuhan plant, for example, the Soviets withdrew before planned finishing facilities were constructed. The Chinese have been able to produce only a small variety of finishing equipment on their own. In 1978, finished steel production amounted to about 21 million tons, only two-thirds of crude steel output.

China's steelfinishing capacity consists primarily of large blooming and structural mills and a considerable number of rod and bar, plate, sheet, and welded and seamless tube mills. The PRC has few wide sheet or strip mills, or tinning or galvanizing lines. Little cold rolling capacity exists as most mills are designed for only hot rolling.

Recognizing their need for additional steelfinishing capacity, the Chinese in 1973-74 contracted with Japan and West Germany for a $500 million complex to be installed at the Wuhan steel mill. This facility features a 3-million-ton, 1,700-millimeter hot strip mill, a continuous slab caster, an electrical sheet plant, a cold rolling mill, and galvanizing and tin-plating lines. The Chinese recently announced that the installation of most of the equipment was complete, and the mill should go on line sometime this year, about three years behind schedule.

**Imports**

China's imports of iron and steel have grown steadily during the 1970s. The domestic steel industry has been unable to supply either the quantity or the variety of output required by the construction and machine-building industries, which together account for 85 percent of Chinese steel consumption. The slow growth of output, coupled with the shortcomings of the steelfinishing sector, has forced the PRC to turn to foreign sources of supply. Imports, which totaled less than $400 million in 1970, amounted to $1.5 billion in 1977. During this period Beijing spent more than $7.7 billion on purchases of foreign iron and steel, making it the largest single category in China's import bill.

Imports of iron and steel are dominated by finished steel items (see table 3). These products account for about 90 percent of total purchases. China imports large amounts of steel plate and sheet, strip, tube and pipe, and alloy steel. Expansion of the petroleum industry requires more and better quality pipe than China's antiquated pipe mills can produce, and thin sheet and strip and cold rolled items are not produced in sufficient quantities for motor vehicles and other machine-building applications. Until domestic finishing capabilities are improved, imports of these items will continue to grow. Finished steel imports exceeded 4.4 million tons in 1977 and probably reached 7 million tons or more in 1978. In addition, China imports small quantities of crude and semifinished steel. About 250,000 tons valued at $44 million were purchased in 1977.

China's efforts to utilize more fully its blast furnace and steelmaking capacity have led to increased imports of iron ore and pig iron. As noted earlier, China produces insufficient amounts of both items to keep its iron and steelmaking facilities fully employed. Iron ore purchases totaled 2.4 million tons in 1977, almost five

Table 3

**China: Imports of Iron and Steel**

| | Million US $ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
| **Total** | **377.1** | **451.1** | **503.3** | **930.6** | **1,196.7** | **1,453.7** | **1,353.7** | **1,453.7** |
| Pig iron | 1.7 | 23.5 | 24.3 | 52.4 | 90.0 | 51.5 | 29.7 | 70.3 |
| Crude steel | 1.9 | 4.3 | 1.5 | 33.4 | 71.4 | 105 | 59.9 | 44.3 |
| Finished steel | 358.5 | 402.5 | 449.0 | 799.6 | 984.5 | 1,248.7 | 1,232 | 1,310.2 |
| Iron ore | 5 | 6 | 7 | 9.4 | 27.2 | 27.8 | 26.6 | 27.7 |
| Scrap | 10 | 14.8 | 21.5 | 35.8 | 23.6 | 20.7 | 5.5 | 1.2 |
| | Thousand Metric Tons | | | | | | | |
| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
| Pig iron | 26.3 | 487.2 | 488 | 789.2 | 756.9 | 440.5 | 328.3 | 846.8 |
| Crude steel | 14.7 | 39.7 | 10.2 | 234.9 | 416.3 | 557.5 | 356.6 | 256.0 |
| Finished steel | 2,143.7 | 2,198.4 | 2,295.6 | 3,456.1 | 3,230.2 | 3,307.6 | 3,945.5 | 4,422.6 |
| Iron ore | 500 | 600 | 700 | 934.5 | 2,730.1 | 2,474.5 | 2,369.8 | 2,405.0 |
| Scrap | 165.2 | 345.4 | 560.2 | 581.6 | 252.8 | 241.5 | 65 | 17.5 |

times that purchased in 1970. Imports in 1978 probably reached 6 million tons. Imports of pig iron peaked in 1977 at 847,000 tons, worth $70 million. In comparison, pig iron purchases in 1970 were only 26,000 tons. Scrap imports have fallen steadily since they reached almost 600,000 tons in 1973. Imports in 1977 were less than 20,000 tons.

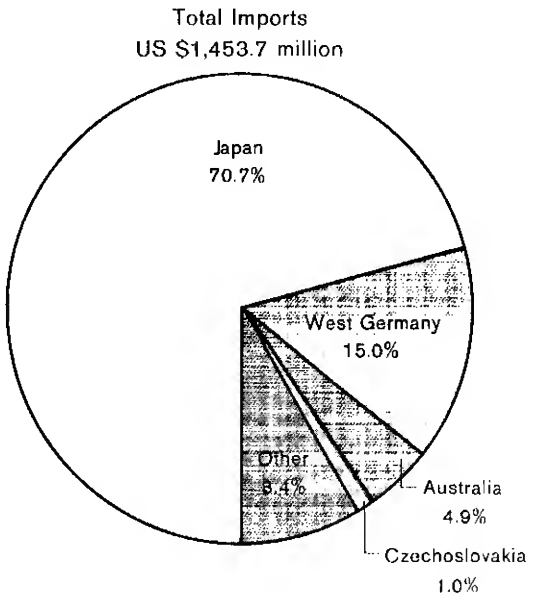
Japan is by far the largest supplier of iron and steel to China (see figure 3). With 1977 sales of more than $1 billion, Japan accounted for 70 percent of China's total iron and steel imports. Japanese sales are concentrated in finished steel products, particularly steel plate and sheet. West Germany is China's second leading source. German iron and steel exports to the PRC amounted to $218 million in 1977, almost three-fourths of which consisted of steel tube and pipe. Australia, China's leading source of iron ore, is the third largest overall supplier of iron and steel. Australia also sells considerable quantities of pig iron.

Despite growing purchases of iron and steel, China's total steel supply—production plus imports—has grown slowly during the 1970s. Between 1970 and 1978 supply grew almost 8 percent annually, but between 1970 and 1977 the rate was only a little over 5 percent. Not until 1978 did total supply surpass the previous peak reached in 1973 (see table 4). The slow growth of supply indicates that Beijing must maintain steel imports at a high level if it is to carry through its sweeping modernization program. During the 1970s imports have accounted for about 15 percent of total steel supply, and more than 20 percent of finished steel supply. Domestic output will be insufficient to provide the required amounts of steel well into the 1980s; thus, the PRC will be forced to continue large-scale steel imports—at a considerable cost in scarce foreign exchange or amassed debt.

### The Modernization Program

China's program to modernize its steel industry is intended to redress longstanding bottlenecks and to double existing capacity and output by 1985. The industry today is plagued by imbalances between sectors and dated technology. The weak links—principally mining and processing of iron ore and

**China: Imports of Iron and Steel by Countries, 1977** Figure 3

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finishing capabilities—need improvement, and existing plants require infusions of modern technology to boost productivity. Fuller use of existing capacity is not a promising solution, since the steel industry has recently been operating at more than 90 percent of capacity. Perhaps another several million tons of output could be squeezed out of existing plants, but any large increase in production must await new capacity coming on stream. Only by introducing modern technology and constructing new plants can China hope to restore internal balance to the industry and increase output sufficiently to meet the rapidly growing demand for steel.

***Planned Facilities***

The 10 steel centers China plans to construct by 1985 consist of two or three totally new facilities and expansion of seven or eight existing plants. New facilities are planned for Shanghai and eastern Hopeh Province. Existing plants reportedly slated for expansion and upgrading include Anshan, Benxi, Capital, Baotou, Taiyuan, Wuhan, Maanshan, and possibly Chongqing.

**Table 4** Million Metric Tons

**China: Supply of Steel**

| | Production | Imports | Supply |
|---|---|---|---|
| 1970 | 17.8 | 2.2 | 20.0 |
| 1971 | 21.0 | 2.2 | 23.2 |
| 1972 | 23.0 | 2.3 | 25.3 |
| 1973 | 25.0 | 3.7 | 28.7 |
| 1974 | 21.0 | 3.6 | 24.6 |
| 1975 | 24.0 | 3.9 | 27.9 |
| 1976 | 20.5 | 4.3 | 24.8 |
| 1977 | 23.7 | 4.7 | 28.4 |
| 1978 [1] | 31.7 | 5.0 | 36.7 |

[1] Preliminary.

A preliminary contract for the initial project, the Baoshan steel plant near Shanghai, was signed with Japan's Nippon Steel Corporation in April 1978. This plant has a designed capacity of 6 million tons; half to be operational by January 1981. The remainder is scheduled to come on line two years later. Groundbreaking ceremonies took place in mid-December, and pilings are currently being placed. The plant's coastal site has a soft geological structure, and pilings for the blast furnaces and heavy equipment in the rolling mill will extend to a depth of 70 meters. Altogether, about 300,000 tons of steel pilings will be required for the plant.

Baoshan's coastal location was chosen despite its poor geology to facilitate transportation of imported iron ore. When fully operational, the plant will probably use more than 10 million tons of foreign iron ore yearly, most of which will likely come from Australia and Brazil. Inland shipment of the ore would place additional strains on China's already overburdened transport system. Moreover, the plant will be able to provide the heavily industrialized Shanghai area with an expanded supply of high-quality steel. The Chinese anticipate this will help boost industrial production in the area.

The Baoshan plant will incorporate the latest steelmaking technology. The facility is to be modeled on Nippon's Kimitsu plant, one of the most modern in the world.

Sumitomo Metal Industries will construct a 400,000-ton seamless pipe mill as part of the Baoshan complex. Sumitomo had previously refused to sell its superior plant design and layout, but apparently hopes this will help win additional contracts for plants to be built later. This mill, which produces primarily oil drilling pipe, is scheduled to be completed in 1981.

Negotiations on price and payments terms for the Baoshan project are not yet complete, but most cost estimates fall between $3 billion and $4 billion. This total includes funds for related facilities such as power plants, port improvement, and site preparation. The Baoshan plant alone will cost roughly as much as all of China's industrial plant imports in 1972-77.

Preliminary discussions have been held with Japanese and West German firms for the construction of a 10-million-ton plant near Qinhuangdao (Chin-huang-tao) or Jidong (Chi-tung) in the Bo Hai (Po Hai) Bay area of Hebei Province. This could be one of the world's largest steel mills. The plant will be located in an earthquake-prone area near Tangshan. Large reserves of iron ore are available, however, and the Kailuan coal mines are nearby. The facility will also have access to several ports and will be able to serve the Tianjin industrial center.

A West German consortium led by Scholemann-Siemag AG has been actively pursuing this contract. The companies have proposed a two-stage construction program that would see completion of the first stage, with a capacity of 6 million tons, in 1985. The Chinese have indicated a preference for a German plant, noting that while Japanese mills use high-quality imported iron ore and coking coal, German plants are designed to use raw materials of a quality similar to that available in China. Dresdner Bank has proposed a 10-year, 28-billion-mark credit to finance the package. If the bid is successful, the size of the order would be a record for German companies and would be accompanied by one of the largest credits ever granted. In early 1979, however, Chinese leaders began to harbor serious doubts about pushing ahead with this project in the short run.

Talks have also been held with several Japanese and British steel firms for the construction of the Hebei facility. China has asked Nippon Steel to submit a proposal for the Hebei plant. Nippon is reluctant to commit itself to the project and has suggested that other firms might be in a better position to assume responsibility for the undertaking.

The enlargement and modernization of existing plants will be accompanied by a combination of Chinese and foreign efforts. China has the capability to produce a wide variety of basic steelmaking equipment and will likely supply some of the more simple items. Foreign participation will probably center around large-scale capacity additions and the provision of technically advanced pieces of steelmaking equipment. In addition, foreign firms will undoubtedly supply a variety of engineering and technological services.

The modernization and rounding out of existing plants offers many benefits to China. Internal balance can be achieved, and obsolete production processes can be scrapped. In some cases, new equipment is vital if other segments of a plant are to perform up to design. At Wuhan, for example, the new continuous caster requires more frequent supplies of hot metal than open-hearth furnaces can supply and the new BOFs China added in 1977 are very small. This plant is thus a logical site for a large BOF. Indeed, the Chinese have expressed interest in Q-BOP, or bottom-blown oxygen furnace developed by a US firm. Moreover, expansion of existing facilities is generally less expensive than building new greenfield plants. Brand new capacity costs about $1,000 per ton, while brownfield costs average about $500 per ton.

The order in which China plans to upgrade existing facilities is unknown. China has, however, made inquiries with a number of firms in Japan, Western Europe, and the United States about enlarging and modernizing selected installations (see table 5).

**Table 5** Million Metric Tons

**China: Plans for Enlarging Steel Plants**

| Plant | Current Capacity | Projected Capacity |
|---|---|---|
| **Total** | **19** [1] | **41** [2] |
| Wuhan | 3.5-4 | 6 |
| Maanshan | 1.5-2 | NA |
| Baotou | 1.5-2 | 3 |
| Capital (Beijing) | 1.5-2 | 5 |
| Anshan | 7 | 15 |
| Benxi | 2 | 12 |

[1] Maximum capacity.
[2] Excluding Maanshan.

Implementation of these plans will yield a minimum of 24 million tons of new capacity. This new capacity, when combined with the Hebei and Baoshan installations, could increase China's steelmaking capacity by 40 million tons, boosting the overall figure to more than 70 million tons. A capacity utilization rate of 85 percent would enable China to reach its target of 60 million tons of output.

China has also begun to award contracts for improvements at some of its smaller steel mills. Daido Steel Company of Japan recently announced that it has agreed to provide technical assistance for the modernization of four medium-sized steel plants at Fushun (Fu-shun), Luda, Daye, and Tiajin. The eventual cost of these projects will probably be approximately $300 million to $500 million.

***Iron Ore Development***

China has abundant supplies of the natural resources necessary to become a major steel producer. Iron ore, coal, and limestone deposits are widespread and plentiful. In addition, China has large reserves of alloying materials such as manganese, molybdenum, tungsten, and vanadium. The most serious shortages are in certain alloying materials, particularly cobalt and chromium; China needs to import nearly its entire supply of these two metals.

Reserves of iron ore are huge. Published estimates range from a pre-1949 figure of 2 billion tons to the Chinese claim of 100 billion tons made during the Great Leap Forward. Total reserves probably approach the latter figure. In any event, reserves are more than sufficient for foreseeable requirements.

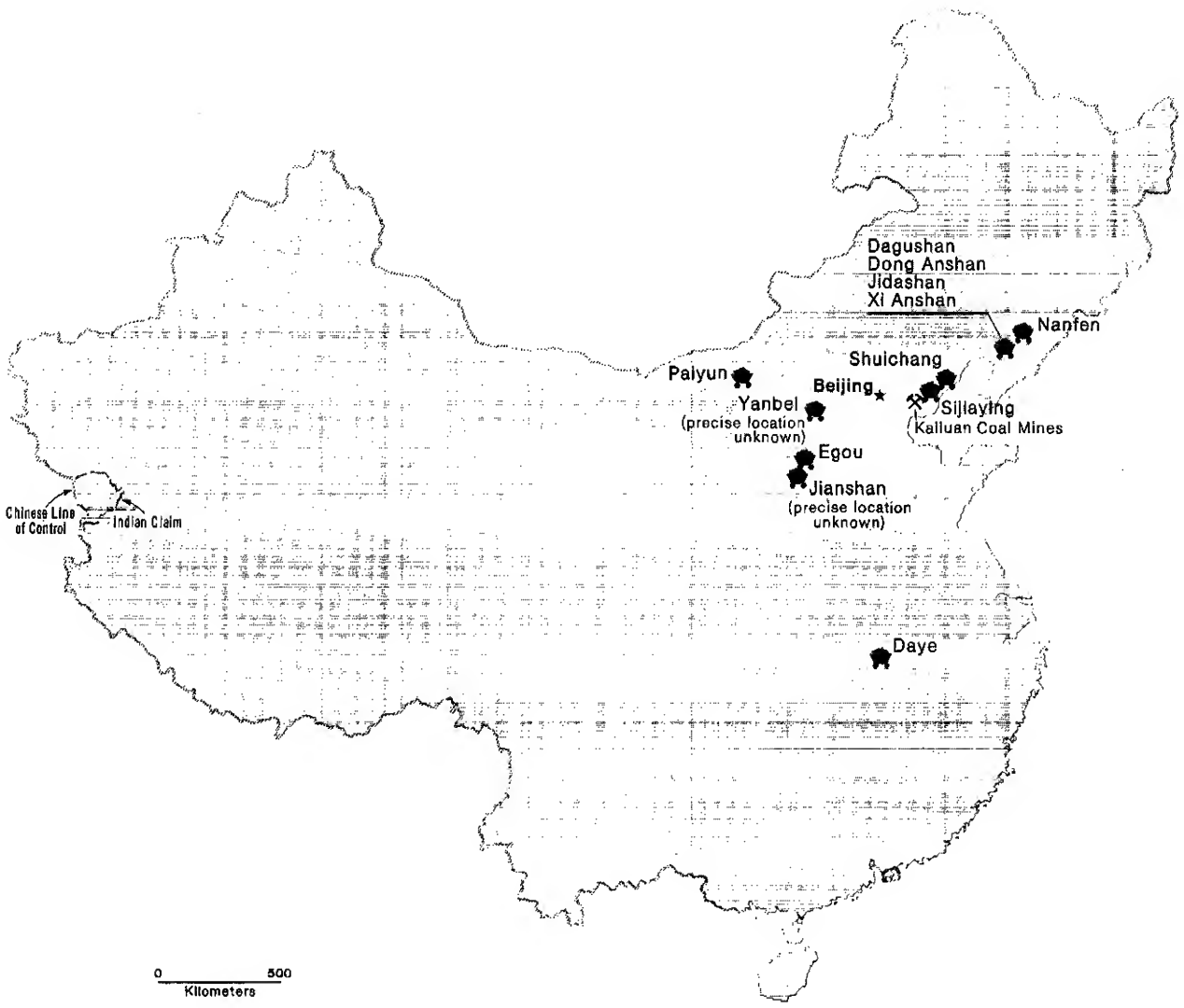
Much of China's iron ore is low quality. Although scattered deposits of high-quality ore exist, the bulk is probably around 30-percent iron content. Ores of this grade require extensive beneficiation before being fed into ironmaking furnaces. Despite foreign advice, China so far has been slow to invest in adequate beneficiation facilities.

With the exception of the Baoshan plant, all of China's new or expanded steel centers will be located near supplies of iron ore. China plans to develop its iron ore resources quickly so these plants will be able to use domestic ore for their growing production. Although Baoshan initially will be supplied with imported ore, the Chinese hope to phase out imports for this plant sometime during the 1980s. Despite China's huge iron ore reserves, an enormous development effort will be required to attain self-sufficiency. China was unable to produce the approximately 60 million tons of standard ore (55-percent iron content) needed for steel production in 1978. By 1985, if the steel goal is reached, standard ore requirements will reach about 120 million tons, more than double current production. In addition, as the PRC is forced to move to poorer deposits, actual tonnages mined will have to exceed standard ore requirements by growing margins.

The Chinese program to increase iron ore output features the development or expansion of approximately 14 major mines. Most of these are located in North, Northeast, and Central China, each having a potential for 15-60 million tons of ore annually. The ores at these mines contain only about 30-percent iron, so extensive beneficiation will be necessary. The Chinese apparently plan a widespread introduction of pelletizing plants to upgrade the ore. Currently, modern pelletizing technology is practically nonexistent in China.

Figure 4

## China: Potential Iron Ore Expansion Sites

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The Chinese plan to acquire Western equipment and technology to develop their iron mines and to build pelletizing plants. Three US firms have already received preliminary contracts to develop four mines. Additional proposals are being discussed and more contracts are expected.

Two of the mines for which preliminary contracts have been awarded will supply iron ore to the new steel mill to be built in Hebei Province. These are the Shuichang (Shuich'ang) and Sijiaying (Szechiaying) mines. Each will produce about 10 million tons of pellets yearly. Development of the two mines will probably cost nearly $2 billion. Besides the new Hebei plant, these mines could also supply the Capital and other plants in the Beijing area and may eventually ship pellets to the new plant at Baoshan.

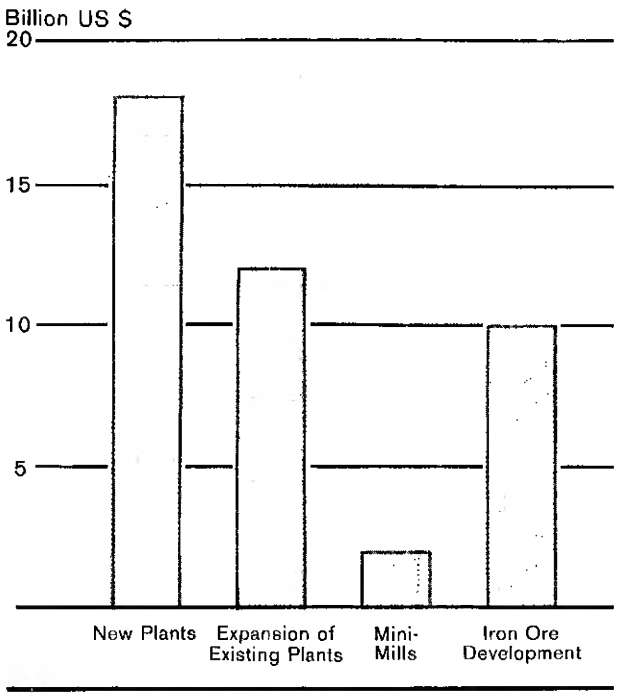
Expansion of the Jidashan (Chi-da-shan) mine will supply some of the ore needed to support the proposed doubling of steel production at Anshan. Production from this mine is set at 17 million tons of pellets. About 45-50 million tons of ore will be required for this level of production. The total cost of this complex could exceed $1 billion. The other mine that will be initially developed is the Nanfen (Nan-fen) mine near the Benxi steelworks. Production may eventually reach 60 million tons of ore that will be converted into approximately 20 million tons of pellets. This project could cost $500 million to $1 billion.

Little precise information is available on the other mines the Chinese plan to develop by 1985. The Chinese are studying a number of other properties, however, and at least some of the following mines will be expanded to help meet China's growing iron ore needs: Dong Anshan (Tung Anshan), Xi Anshan (Hsi Anshan), and Dagushan (Ta Kushan) near the Anshan Iron and Steel Company; the Paiyun (Pai-yun) mine near the Baotou steel mill; the Egou (O'kou) mine near the Taiyuan steelworks; Daye at the Wuhan mill; and the Jianshan (Chien-shan) and Yanbei (Yen-pei) mines in Shanxi (Shansi) Province (see map, figure 4).

***Cost of Steel Expansion Program***

The costs of China's proposed steel expansion program are enormous. Potential plant and technology imports at the 10 steel centers easily surpass $20 billion (see figure 5). Several billion more could be spent on smaller steel facilities. In addition, mine development and beneficiation facilities could add another $5-10 billion to the total. Thus, the potential hard-currency spending on the entire steel industry modernization plan could reach $40 billion.

**China: Potential Cost of the Modernization Program** Figure 5

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**Outlook: Contraction in Goals**

China will undoubtedly be forced to defer its ambitious goal of doubling steel output by 1985. Perhaps the most overwhelming task in achieving the goal is the sheer size of the planned construction program. Since 1957 the Chinese have been able to add, on average, about 1.3 million tons of new steelmaking capacity yearly. The goal of 60 million tons of steel by 1985 requires the addition of 4 million tons of capacity annually for the next seven years. This is an unrealistic target that would be difficult to reach under the best of circumstances.

The supply of skilled construction workers is limited; huge quantities of heavy construction equipment would have to be imported to support the program; and the massive construction effort would also require more inputs of cement and other materials than China can supply. (The Chinese already are experiencing shortages of cement and will become a net importer in 1979 for the first time since the early 1950s. At least 2 million tons will be purchased from Japan this year at a cost of $120 million.)

The decade of upheaval in China's educational system (1966-76) has left a serious gap in the ranks of scientists and engineers, which directly affects the steel program and simultaneously makes it more difficult to pry professional manpower away from other uses. Beijing is attempting to overcome this deficiency by

restoring standards in domestic education and by sending students abroad; results will be slow in coming.

Another problem facing the Chinese is the weak infrastructure associated with building and operating large steel complexes. Transport facilities and electric power systems are backward and barely able to cope with the needs of an industrial sector growing at an average 9 percent a year. As a case in point, the newly opened section of the Wuhan steel mill can only operate four hours per day because of a chronic shortage of electric power.

As evidence that Chinese officials realize their goals for the steel industry are unattainable by 1985, Vice Premier Li Xiannian stated in a March 1979 interview with a Japanese newsman, "The Chinese economic construction plan has some overambitious aspects. We are now thinking about whether major targets, including iron and steel output, should be revised." In addition, Vice Premier Kang Shien indicated in April that the Hebei Province plant and expansion at Anshan would almost certainly be delayed.

Besides their technical inability to reach the steel target, Chinese officials probably are backing away from the 60-million-ton goal because of the tremendous cost of the program. The Chinese have been shocked when presented with cost estimates for various projects. They have started to realize that such high levels of spending would siphon funds from investment in agriculture and light industry and could lead to unbalanced development and tie up investment resources in projects that would not generate returns for many years. In contrast, investment in light industry has a much quicker payoff time.

Given the technical and financial problems described above, we think Beijing will slash its steel target to perhaps 45 million tons. China should be able to reach this level of output with the completion of the Baoshan plant and selected additions to existing mills. The goal of 60 million tons will probably be stretched out to 1990 or beyond. In the longer run, the future of China's steel industry is bright. With its abundant raw materials and the infusion of Western technology, China should eventually be able to develop a steel industry comparable in size to the steel industries of the United States, the USSR, and Japan.